

--	--	--	--	--	--	--	--	--	--

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

HCB1011 – CELL BIOLOGY

(All sections / Groups)

24 OCTOBER 2019

2.30 p.m. – 4.30 p.m.

(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages with 5 Questions only.
2. Answer **ALL THE QUESTIONS**. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please print all your answers **clearly** and **neatly** in the Answer Booklet provided.

QUESTION 1

- (a) Stanley Miller and Harold Urey recreated Earth's early atmosphere in a test tube. Then they bombarded the chemical mixture with ultraviolet light and simulated lightning. What were the results? What do the results imply about the origin of life? [2 marks]
- (b) What were the most likely first living cells on Earth? Explain your answer. [2 marks]
- (c) Macrophages are cells in the human immune system whose job is to take in and then break down potentially harmful materials like germs and cancer cells. Which organelle below would you expect to find in abundance in macrophages? [0.5m]
- (d) Muscle cells have special fibers that use ATP to slide across each other to allow muscle contraction and, thereby, movement. Which organelle below would you expect to find in abundance in muscle cells. [0.5m]
- (e) Name TWO differences between prokaryotic and eukaryotic genomes. [2 marks]
- (f) What cell structures do prokaryotes and eukaryotes have in common? Name FOUR. [2 marks]
- (g) How do prokaryotes make ATP without mitochondria? [1 mark]

QUESTION 2

- (a) Why was Rosalind Franklin's X-ray diffraction picture of DNA so important? [1 mark]
- (b) Why does DNA replication occur in the 5' to 3' direction? [1 mark]
- (c) What are the FOUR steps of DNA replication in the cell? [2 marks]
- (d) Why does DNA replication need to be accurate? How do cells ensure that DNA replication is accurate? [2 marks]
- (e) What is a TATA box? What is its function? [2 marks]
- (f) What is the advantage of the 5 cap and poly(A) tail? [2 marks]

Continued...

QUESTION 3

(a) How does translation differ in prokaryotes and eukaryotes? [1 mark]

(b) There is a single open-reading frame (ORF) in the DNA molecule shown below. Find the ORF in one of the DNA strands. (Recall that an ORF begins with a start codon and ends with a stop codon).

5'-CGATCGCTATAAGGTTGACCTAGAGTTCGATTTACTCGTTTATGTGGCAGGCCATTTCTAAA-3'
 3'-GCTAGCGATATTCCAACCTGGATCTCAAGCTAAATGAGCAAATACACCGTCCGGTAAAGATTT-5'

- i. Write the mRNA sequence derived from this ORF. [2 marks]
- ii. Using the codon chart provided below, translate the mRNA into a protein sequence. Write the protein sequence using single-letter abbreviation for the amino acid residues. [2 marks]

--- CODON CHART ---

		Second Letter											
		U		C		A		G					
1st letter	U	UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys	U	3rd letter		
		UUC		UCC			UAC		UGC			C	
		UUA	Leu	UCA			UAA	Stop	UGA	Stop		A	
		UUG		UCG			UAG	Stop	UGG	Trp		G	
	C	CUU	Leu	CCU	Pro	CAU	His	CGU	Arg	U			
		CUC		CCC			CAC			CGC		C	
		CUA		CCA			CAA	Gln		CGA		A	
		CUG		CCG			CAG			CGG		G	
	A	AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser	U			
		AUC		ACC			AAC		AGC	C			
		AUA		ACA			AAA	Lys	AGA	Arg		A	
		AUG		ACG			AAG		AGG			G	
	G	GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly	U			
		GUC		GCC			GAC			GGC		C	
		GUA		GCA			GAA	Glu		GGA		A	
		GUG		GCG			GAG			GGG		G	

Key:

Ala = Alanine (A)
 Arg = Arginine (R)
 Asn = Asparagine (N)
 Asp = Aspartate (D)
 Cys = Cysteine (C)
 Gln = Glutamine (Q)
 Glu = Glutamate (E)
 Gly = Glycine (G)
 His = Histidine (H)
 Ile = Isoleucine (I)
 Leu = Leucine (L)
 Lys = Lysine (K)
 Met = Methionine (M)
 Phe = Phenylalanine (F)
 Pro = Proline (P)
 Ser = Serine (S)
 Thr = Threonine (T)
 Trp = Tryptophan (W)
 Tyr = Tyrosine (Y)
 Val = Valine (V)

(c) What is the extracellular matrix (ECM) made up of? What is the function of ECM? [2 marks]

(d) What are the THREE types of intercellular junction? What are their roles? [3 marks]

Continued...

QUESTION 4

- (a) Stem cell research has come a long way over the last few decades with many new exciting potential healthcare applications being developed.
- i. What is stem cell therapy? [1 mark]
 - ii. Name TWO defining characteristics of a stem cell. [1 mark]
 - iii. Where do stem cells come from for stem cell therapy? [2 marks]
 - iv. Several issues have been raised about the ethics of embryonic stem cell research. Why can't researchers use adult stem cells instead? [2 marks]
- (b) Cell signaling is a complex system of communication between the cells to regulate cellular activities. With the help of simple diagrams, describe the FOUR forms of chemical signaling. [4 marks]

QUESTION 5

Answer TRUE or FALSE for each of the statements below. If the statement is FALSE, correct the statement. [10 marks]

- (a) Mendel developed the theory of natural selection in the 1800's.
- (b) Nucleus is the control centre of the cell while nucleolus is the control centre of the nucleus.
- (c) Ribosomes are small particles which are found individually in the cytoplasm and also line the membranes of the golgi apparatus.
- (d) Both animal cells and plant cells have centrioles, ribosomes, and mitochondria.
- (e) Facilitated diffusion involves the passage of molecules across a cell wall with the help of specific transport proteins, requiring no energy.
- (f) In most eukaryotic genes, coding regions (exons) are interrupted by noncoding regions (introns).
- (g) Paternal and maternal haploid genomes unite during meiosis to restore full chromosome number.
- (h) Nucleoid is the region in a prokaryotic cell where DNA is double-stranded and generally take a liner form.
- (i) Cells have the same DNA but different appearances because different genes are active in different cells.
- (j) Transfer RNA (tRNA) is the type of RNA molecule that transfer polypeptides to ribosomes to make proteins.

End of Page